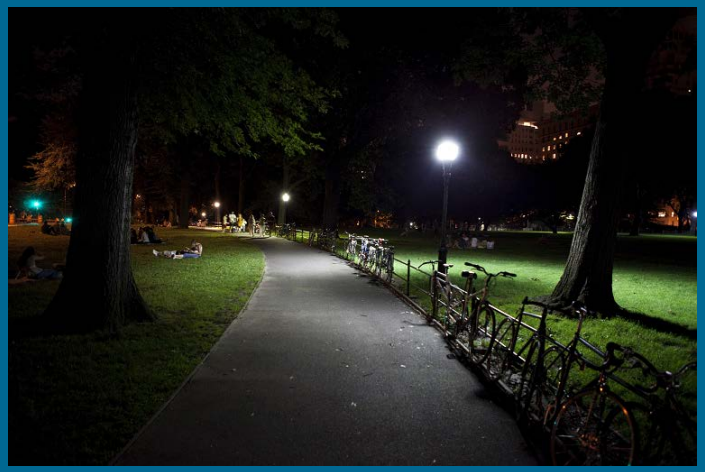
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

GATEWAY Demonstrations: What Have We Learned About LED Performance and Cost Effectiveness?



LIGHTFAIR

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Purpose and Criteria

- GATEWAY projects provide real-world field experience
  - Comparison of LED with incumbent technologies
  - Feedback for manufacturers
  - Objective information for municipalities, utilities, etc.
  - Tracking of year-to-year technological progression
  - Long-term performance monitoring
- GATEWAY projects strive to:
  - Save energy
  - Meet owner expectations or industry standards for lighting quantity and quality
  - Meet owner requirements for cost effectiveness

J. Paul Getty Museum exhibit:
In Search of Biblical Lands
Photo courtesy Getty Museum

Recently Completed

- Museum display lighting – LED Retrofit Lamps
  - JSMA, Eugene OR (published September 2011)
  - Getty Villa, Malibu CA (published March 2012)
  - Smithsonian American Art Museum, Wash DC (est. May 2012)
- Ornamental Street Lighting
  - Sacramento, CA (published Dec 2011)
- LED Street and Roadway Lighting
  - FDR Drive, NYC, NY (published Dec 2011)
  - Cully Road, Portland OR (est. date June 2012)
- Hotel accent and downlighting – LED Retrofit Lamps
  - InterContinental Hotel, San Francisco, CA (updated January 2012)

Chris Jordan Exhibit “Running the Numbers”
Jordan Schnitzer Museum of Art, University of Oregon, Eugene OR

Chris Jordan Exhibit “Running the Numbers”
Jordan Schnitzer Museum of Art, University of Oregon, Eugene OR

Jordan Schnitzer Museum of Art

Photo courtesy Jordan Schnitzer Museum of Art

"Caps Seurat" - Depicts 400,000 plastic bottle caps, equal to the average number of plastic bottles consumed in the United States every minute.

Jordan Schnitzer Museum of Art

Photo courtesy Jordan Schnitzer Museum of Art

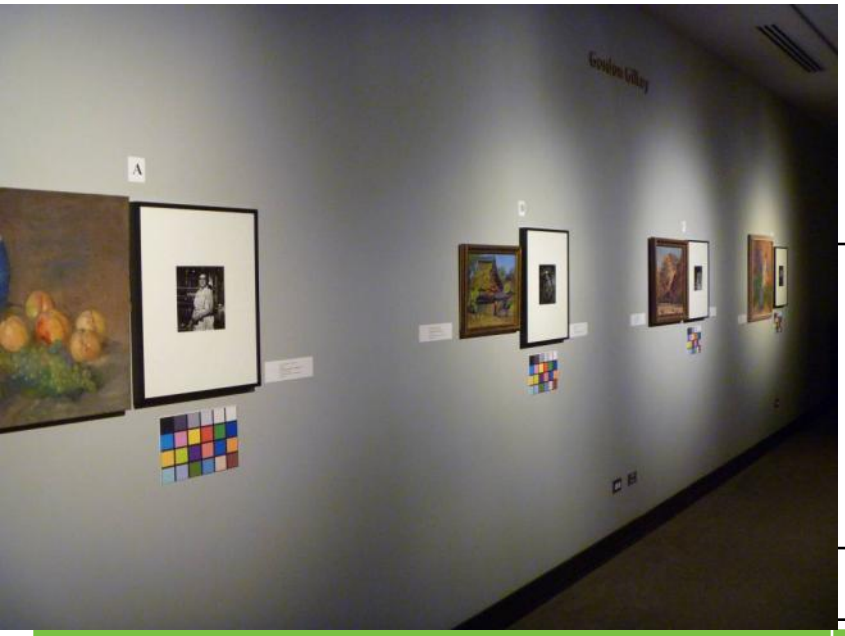
Source	Lamp Type	Total Watts	Energy Savings
Halogen	(49) 90W PAR38 25˚ NFL 130V (79W)	3871	
LED	(54) Cree LRP38 12W 20˚ NFL 2700K (10.2W)	551	86%

Jordan Schnitzer Museum of Art

	Halogen	LED
Total Initial Cost	$265.58	$ 5832.00
Annual Hours of Operation	2548	2548
Operating Power of Lighting System	3871 W	551 W
Annual Ltg. Electric Operating Cost	$591*	$84*
Payback from Lighting alone (Years)	-----	9*
Payback from Lighting + HVAC (Years)	-----	7*
Lifespan (50,000 hrs/2548) Years		19.6

* Note: The JSMA pays only 6c/kWh for electrical power!

Jordan Schnitzer Museum of Art



Viewing public's assessment of four light sources (% with strong preference) in test gallery

			
2700K, 84	2700K, 85	2638K, 93	2821K, 99

	LED Lamp 1	LED Lamp 2	LED Lamp 3	Halogen Par38 Lamp
Overall light distribution on art	0	23	8	23
Ideal warmness / coolness of light	10	37	12	8
Best lamp for oil painting	6	25	15	15
Best lamp for B&W photo	1	29	14	4

“In Search of Biblical Lands” Exhibit, The Getty Villa, Malibu CA (photo courtesy of The J. Paul Getty Museum)

Photo courtesy The J. Paul Getty Museum

Source	Lamp Type	Total Watts	Energy Savings
Halogen	(34) 60W PAR38 30˚ 120V 	2040	
LED	(34) 12W LED PAR38 20˚ (10.2W) 	347	83%

In Search of Biblical Lands Exhibit

	Halogen	LED
Total Initial Cost (Lamps only)	$184.00	$3398.00
Annual Hours of Operation	2652	2652
Operating Power of Lighting System (W)	2040	347
Annual Ltg. Electric Operating Cost	$649	$110
Payback from Lighting alone (Years)	-----	2.3*
Payback from Lighting + HVAC (Years)	-----	2.1*
Lamp Lifespan (25,000 hrs/2652) Years	-----	9.4

* Melded electric rate of 12c/kWh

Smithsonian American Art Museum.
Lighting and photography by Scott Rosenfeld

Smithsonian American Art Museum, Rose Gallery (Halogen lamps)
Lighting and photography by Scott Rosenfeld

Smithsonian American Art Museum, Rose Gallery (LED replacement lamps)
Lighting and photography by Scott Rosenfeld

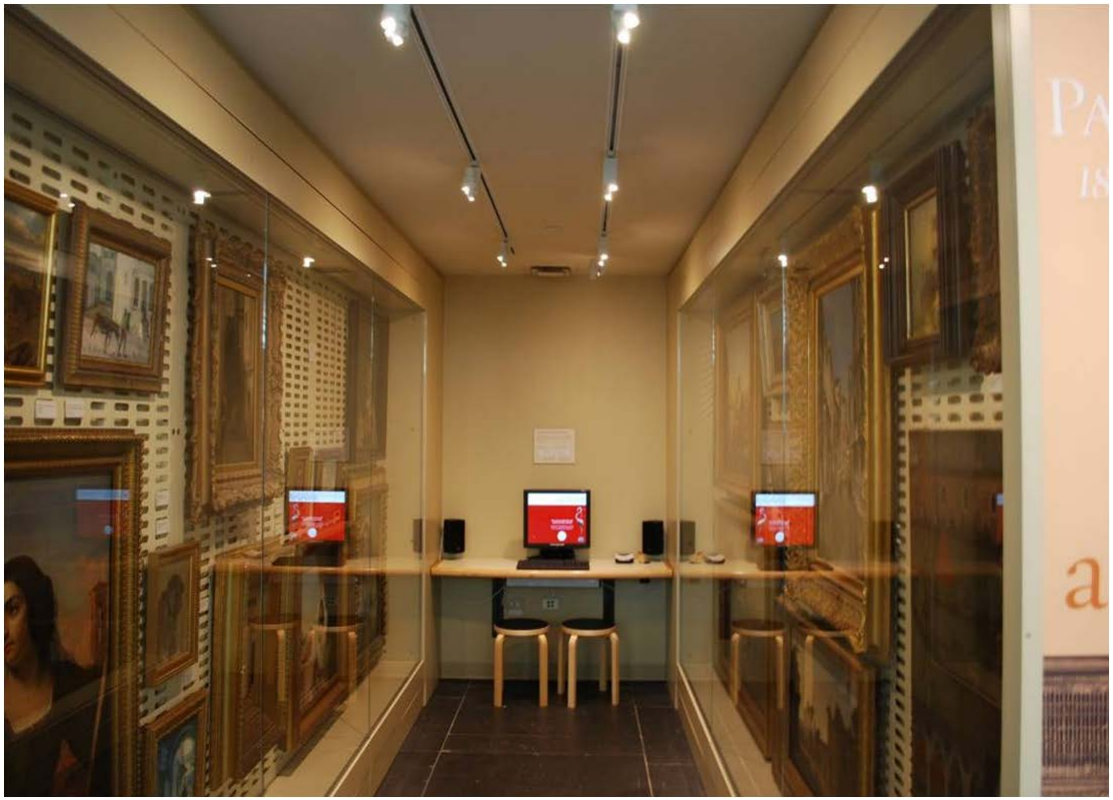
Julie Walters and Sam Rose Gallery

	Halogen	LED
Total Initial Lamp Cost	$466	$5610
Annual Hours of Operation	4500	4500
Operating Power of Lighting System	4737 W	1296 W
Annual Ltg. Electric Operating Cost	$2984*	$816*
Payback from Lighting alone (Years)	-----	1.4*
Payback from Lighting + HVAC (Years)	-----	1.1*
Lifespan (25,000 hrs/4500) Years		5.6

*At 14c/kWh melded electrical rate

Smithsonian American Art Museum

- Luce Center Gallery of Art – Existing system uses 50W MR16 halogen lamps on electronic transformers. Whole system is controlled by preset dimming system.



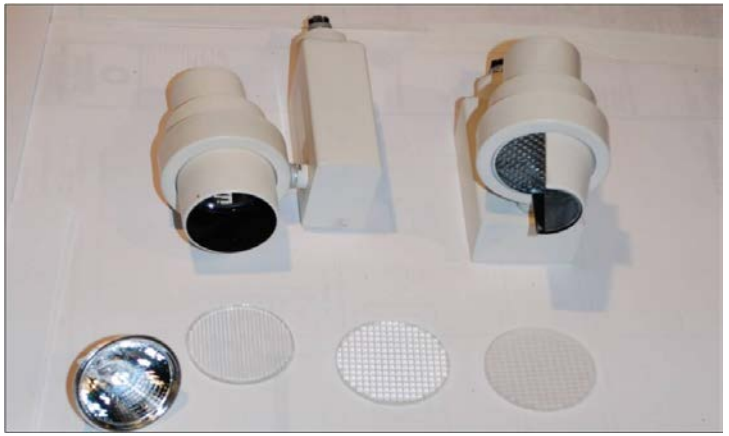


Photo Credit: Scott Rosenfeld

So far, no MR16 LED replacement lamp can light the gallery without flicker or other poor performance.

Reprise – InterContinental Hotel SF

InterContinental Hotel, San Francisco, CA (Original work 2010)

- 6W LED replaced 20W and 30W halogen MR16
- 11W LED replaced 75W halogen PAR30
- 36 MWh annual energy savings, at $0.13/kWh
- Simple payback period of 2 years
- Reduced maintenance

Photo Credit: Kenneth Rice

LED Hotel Retrofit Lamps

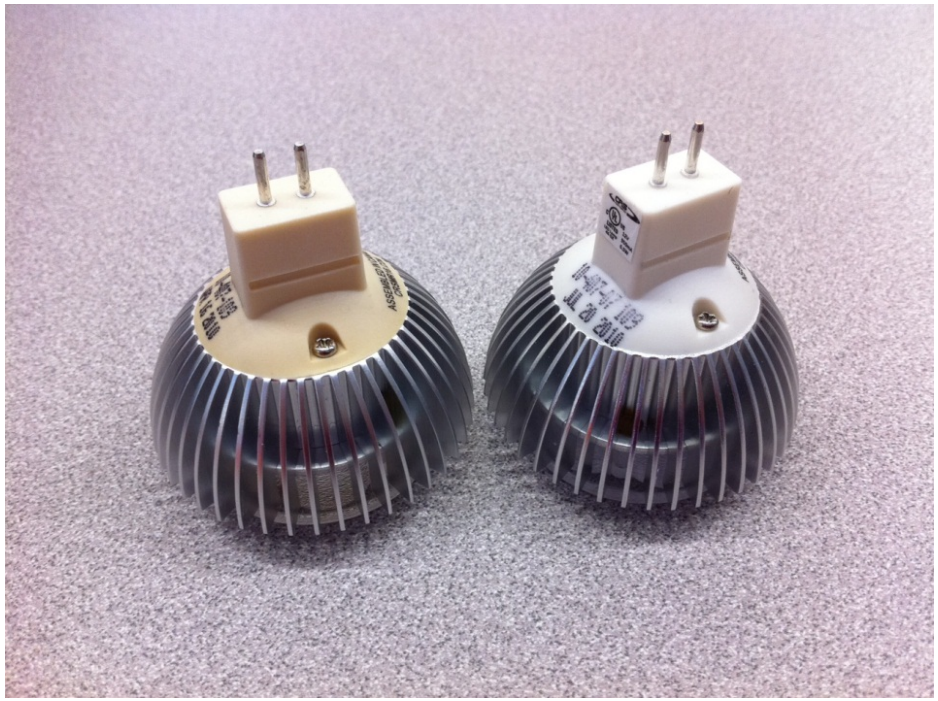
Halogen

LED

Photo Credits: Kenneth Rice

LED Hotel Retrofit Lamps

At 9000 hours of operation: LED lamps dropped in light output and flickered noticeably. Driver capacitors failed due to prolonged heat.



MR16 lamp on left shows discoloration from high temperature operation in existing enclosed fixture at right (measured at 97°C)

How to access reports

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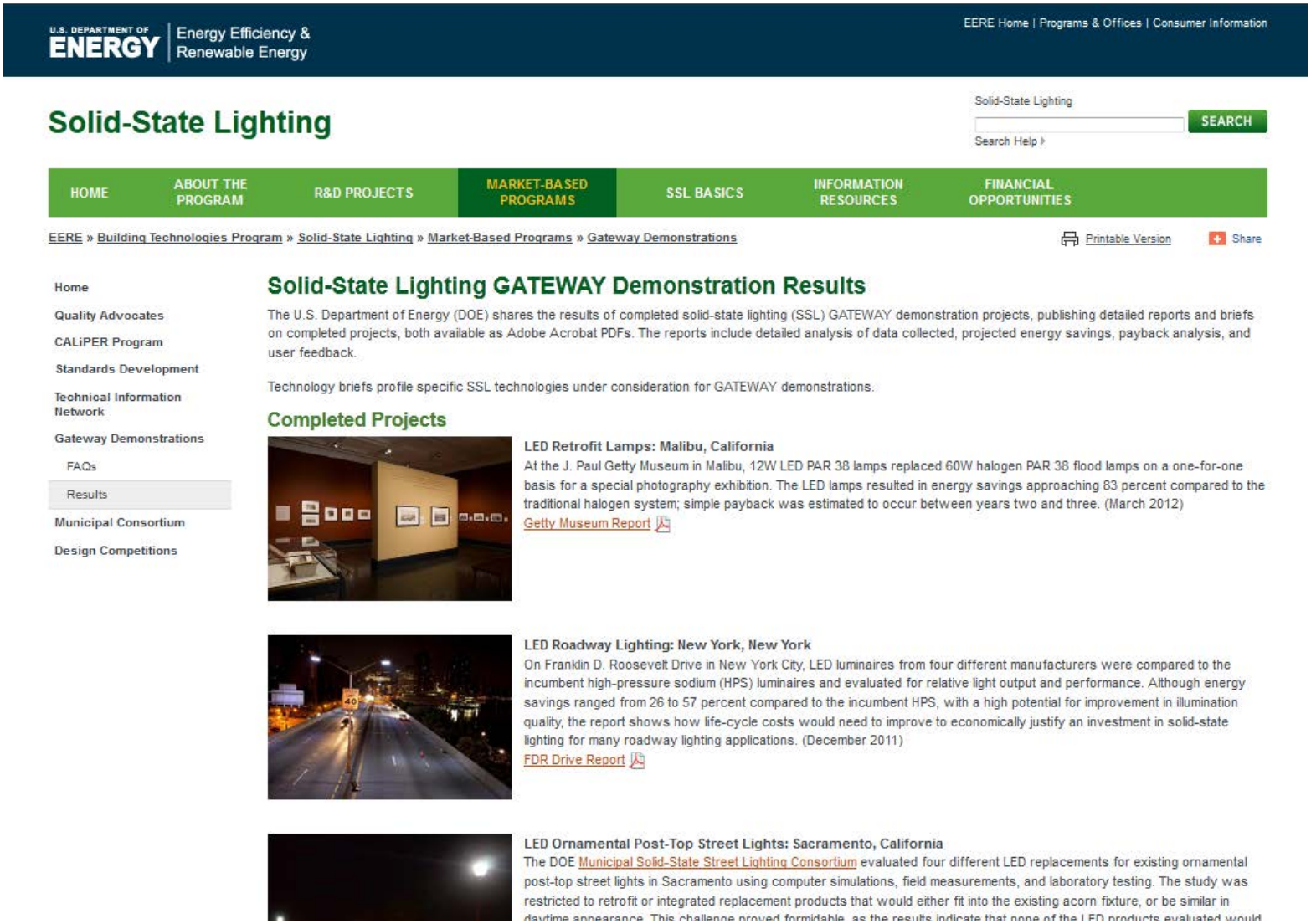

http://www.ssl.energy.gov/gatewaydemos_results.html

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Questions?